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ABSTRACT

Although interdisciplinary teaching has long been supported as a pedagogical practice, little research has looked closely at interdisciplinary teaching. A literature review was undertaken, therefore, to articulate the current theoretical understanding of interdisciplinary education and to examine how it influences practice in middle and high schools. Four questions were considered: What is interdisciplinary education?; How do the disciplines interrelate in practice?; What facilitating and/or problematizing factors impact interdisciplinary instruction?; and What are its effects upon students, teachers, and the school environment? A broad range of articles on interdisciplinary programs in grades 5 through 12 were examined, under the following headings: (1) language and vocabulary associated with interdisciplinary education; (2) types of disciplinary combinations described in the literature; (3) what actually happens in classrooms using interdisciplinary approaches; (4) factors that facilitate interdisciplinary programs; and (5) influence of interdisciplinary programs on teachers and students. For the review's purposes, an interdisciplinary continuum is composed of three ways of knowing that represent stages of disciplinary blending. Knowledge moves from being correlated (stage one) to being shared (stage two) to being reconstructed (stage three) along a continuum in which the disciplines move from being distinct and separate, to being combined with boundaries preserved, to being blended until disciplinary distinctions are no longer evident. Findings suggest that issues in literacy, curriculum, assessment, and institutional support are all of primary importance in effective interdisciplinary programs. Also, an interdisciplinary curriculum forces teachers to reconsider their role as expert/teacher of a single discipline. (Contains a figure showing the continuum model, 4 tables, and 63 references.) (NKA)

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THE INTERDISCIPLINARY CONTINUUM: RECONCILING THEORY, RESEARCH AND PRACTICE

By Mary Adler and Sheila Flihan

INTRODUCTION

> Crossing boundaries. A holistic, interactive, developmental process. A marriage between intuition and analysis. A cross-cultural view of human behavior. A sense of ownership in the learning process. A real world experience. A new coherence. A journey in uncharted waters.

The phrases above reflect the abundance of enthusiasm for interdisciplinary education dating from the present to as far back as the 1920's. Interdisciplinary teaching has long been supported as a pedagogical practice. It is emphasized in John Dewey's work (1956), which critiqued learning a subject in isolation: "It was segregated when it was acquired and hence is so disconnected from the rest of experience that it is not available under the actual conditions of life" (p. 49). It is, in the words of Paul Diederich (1996), the "main curricular innovation" of the landmark Eight Year Study (p. 353).[1] It is implied in Howard Gardner's Multiple Intelligence theories (1993). And it is suggested by James Banks (1981), who claims that "a conceptual approach will facilitate the implementation of a multiethnic curriculum which cuts across disciplinary boundaries" (p. 114). In 1988 interdisciplinary education was identified as an issue of primary importance by members of the Association of Supervisio11n and Curriculum Development (Jacobs, 1989b). Further indicating a resurgence of interest among practitioners, in 1991 and 1997 two major teaching journals published entire issues on interdisciplinary education (*Educational Leadership* and *English Journal*, respectively).

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[1] The Eight Year Study was a progressive program begun in the 1930s in which 30 schools and over 300 colleges and universities experimented with removing college admission requirements in order to free students to pursue alternative goals and democratic ideals (Kahne, 1995).

It is doubly surprising, given this wide range of support, that there is little research that looks closely at interdisciplinary teaching. The literature largely consists of anecdotal and classroom-based accounts, as well as opinion papers, "how-to" suggestions, and definition pieces. The field is thus both large and ill-defined. Moreover, it is complicated by a lack of shared vocabulary and a distinct absence of a body of past research that would help to formulate a much-needed theoretical framework.

The wide variety of non-research based literature that does exist provides one crucial piece of information: Interdisciplinary education persists. School districts, school sites, and local classroom teachers are publishing reports of cross-curricular programs around the country. In terms of actual numbers, in a national survey of 10,365 accredited public and private high schools, Cawelti (1994) found that interdisciplinary teaching was reported to be in general use by 19.6% of the 3,380 respondents, partially implemented by 26.2%, and planned for the next year by 15.9%. (Cawelti notes that these data "could be subject to a possible non-response bias" [p. 6]. This is likely, since the survey was specifically focused on restructuring, and non-restructured schools may have been less likely to respond. The survey response rate was only 33%.)

The uneven balance between accounts of theory, research, and practice does not present an optimal foundation for a review of the literature. However, it does provide an opportunity to reflect upon how each of the three types of literature relate to one another. Additionally, the apparent resurgence of interdisciplinary practice on a national scale increases the need for an increased awareness of how the field has been shaped thus far.

The purpose of this literature review, therefore, is to articulate the current theoretical understanding of interdisciplinary education and to examine how it influences practice in middle and high schools nationally. As such, it will consider four questions as they relate to the literature:

1. What is interdisciplinary education?
2. How do the disciplines interrelate in practice?
3. What facilitating and/or problematizing factors appear to impact interdisciplinary instruction?
4. What are its effects upon students, teachers, and the school environment?

In considering these questions, we seek less to produce a comprehensive account of inter-disciplinary instruction than to collect areas of agreement in the field, highlighting locations of consensus while revealing gaps in published information. As such, we hope to suggest possibilities for future research in the interest of forming a knowledge base for both emerging school projects and future research.

SEARCH AND SELECTION PROCEDURES

In an attempt to understand the notion of interdisciplinary studies and its current status in secondary education, efforts were made to locate a broad range of literature on interdisciplinary programs in grades five through twelve. These search efforts yielded reviews, anecdotal information, conference papers, book chapters, and a very small number of research articles.

To be considered for possible review the literature had to focus on cross-curricular education generally or in grades five through twelve. Specifically, literature describing the integration of two or more disciplines was included. Discussions about integration within disciplines were also considered. The articles found through this initial broad-based search provided us with a sense of the current status of interdisciplinary studies at the secondary level. The search continued as long as articles continued to provide new information that enhanced our understanding of the field. In the end, anecdotal and advocacy pieces that simply repeated what we had already learned were not included.

Organization of the Literature

The articles are discussed under six headings. First, we examine the language and vocabulary associated with interdisciplinary education. Second, we turn to the types of disciplinary combinations that are described in the literature. Third, we discuss what actually happens in classrooms where interdisciplinary approaches are used. Fourth, we describe factors that facilitate interdisciplinary programs. Finally, we turn to the influence of interdisciplinary programs on teachers and students, respectively.

DEFINITIONS

When examining interdisciplinary education one soon becomes bogged down by vague definitions, too subtle distinctions among curricular labels, and a sorely lacking shared vocabulary. This issue is revealed throughout the literature in the haphazard use of terms like *integrated* and *interdisciplinary*. It is also revealed in the expanse of literature that focuses, solely or in part, on identifying and making distinctions in terminology that describe or label combinations of two or more disciplines (Beck, Copa & Pease, 1991; Drake, 1991; Fogarty, 1991; Jacobs, 1989a, 1989b; Kain, 1993; McIntosh & Meacham, 1992; Nissani, 1995; Petrie, 1992; Tchudi & Lafer, 1996; Wood, 1997; Vars, 1991).

We thus approach the issue of defining what Nissani (1995) refers to as a "fluid" and "multidimensional" field with some amount of caution, keeping in mind Panaritis' (1995) point that "the underlying distinctions on which such interdisciplinary theories and models depend are often either fundamentally irrelevant or hopelessly arcane" when translated into actual practice (p. 627). Specifically, we seek to address the issue Kain (1993) raises when he asks, "What vision of knowledge is represented in an integrated or interdisciplinary approach to education?" (p. 316). Since our intent is to bring together issues of theory and practice, we might rephrase the question as, "What vision of knowledge is reflected in the interdisciplinary classroom?" The answer, not surprisingly, looks more like a continuum than a discrete set of definitions.

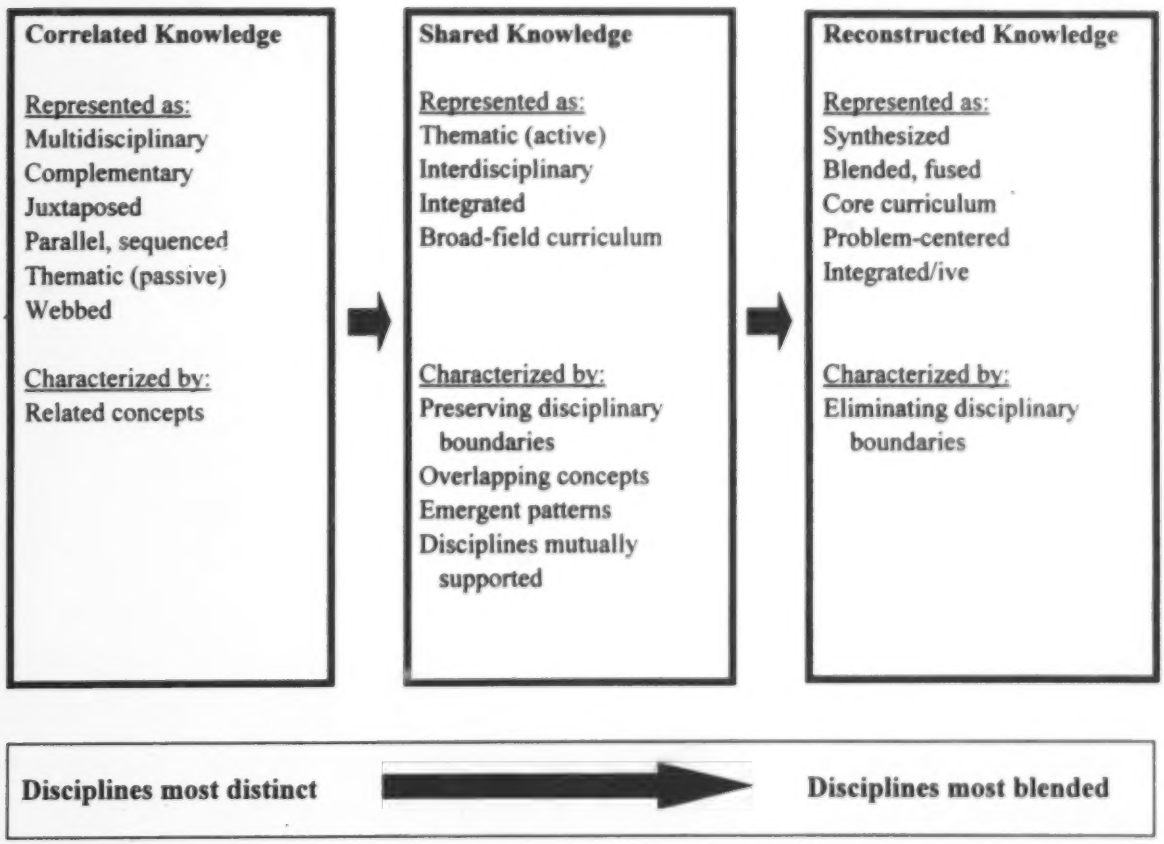
The Interdisciplinary Continuum

Although both integrated and interdisciplinary are widely used in the field, integrated is potentially troublesome to use as an overall term due to its prevalence in unrelated areas of education. For instance, a simple ERIC search of the word turns up articles from busing to heterogeneous grouping. Interdisciplinary, on the other hand, literally refers to a "study of relationship among disciplines" (Doebler, 1980, p. 11). Tchudi and Lafer (1996) support this distinction: they use integration as an omnibus term, but state "we'll stick with the ID [interdisciplinary] word, however, because schools have deep disciplinary roots and,

shortcomings and all, the disciplines have and will continue to be the major engines in the creation of knowledge" (p. 11). We will use "interdisciplinary" to refer to areas of educational research, knowledge, or theory (Nissani, 1995) that combine two or more disciplines.

As we examine the relevant literature, we refer to an interdisciplinary continuum (Figure 1) as being composed of three ways of knowing that represent stages of disciplinary blending. Knowledge moves from being **correlated** (stage one) to being **shared** (stage two) to being **reconstructed** (stage three) along a continuum in which the disciplines move from being distinct and separate, to being combined with boundaries preserved, to being blended until disciplinary distinctions are no longer evident. This model attempts to create a frame that organizes the theoretical models that correspond to reports of interdisciplinary education in practice.

Figure 1:
The Interdisciplinary Continuum



Correlated Knowledge. Correlated Knowledge represents the first stage beyond the traditional disciplines in interdisciplinary education. This vision of knowledge is one that retains traditional disciplinary ways of thinking but attempts to demonstrate broad-based connections between subjects. Beck, Copa, and Pease (1991) and Vars (1991) use *correlated* in a similar fashion, meaning "Teachers of different subjects all deal with aspects of one topic at the same time" (Vars, 1991, p. 14). It is represented in some models as *multi-disciplinary* (Beane, 1991; Drake, 1991; Jacobs, 1989b; Petrie, 1992; Scriven, 1994). Petrie comments that in this stage "any integration is simply assumed to take place in the heads of individual students rather than there being a carefully thought-out system of general education" (p. 303). This comment, though placing value in ways we do not intend, demonstrates the correlated nature of the curriculum, with information placed side by side in a fashion sometimes described as *parallel* or *sequenced* (Fogarty, 1991; Jacobs, 1989a). The far edge of this stage (closest to stage 2, Shared Knowledge) is represented as *thematic* or *webbed* (Fogarty, 1991; Wood, 1997) in which "a fertile theme is webbed to curriculum contents and disciplines" (Fogarty, 1991, p. 63). *Thematic* is a general feature of interdisciplinary curricula (Wood, 1997) and is not restricted to this stage; however, it is included here specifically because thematic teaching in practice often resembles a correlating of the disciplines in which related concepts are connected and material is *sequenced* or *correlated* to make those connections obvious. We refer to this as *thematic (passive)* because the active portion of the learning environment remains focused upon the individual disciplines. In other words, the primary amount of energy is expended within the traditional discipline itself, with ancillary attention given to promoting a common theme.

Shared Knowledge. The second stage in the interdisciplinary continuum focuses upon knowledge as something to be actively shared between disciplines. This stage, Shared Knowledge, is characterized by overlapping concepts and emergent patterns (Drake, 1991; Fogarty, 1991), and mutually supportive disciplines that nonetheless retain their own identities. Active *thematic* units in which connections and patterns are made explicit and in which concepts are explored in depth (as they relate to the different disciplines) belong within this stage. Shared Knowledge is represented in the field largely by the term *interdisciplinary* itself (Drake, 1991; Jacobs, 1989a; McIntosh & Meacham, 1992; Romey, 1975; Scriven, 1994). McIntosh and Meacham (1992) describe a unit on change, noting that "Teachers of the various

disciplines help students to see the relationships among the disciplines. In fact, many of the student projects are designed so that students explore the ways themes present themselves in many disciplines" (p. 4). Fogarty (1991) describes this stage as *integrated*, referring to a *cross-disciplinary approach* that "is a result of sifting related ideas out of subject matter content" (p. 64). In vocational education programs this concept translates into *broad-field curriculum* (Beck, Copa & Pease, 1991), in which common goals are explored by disciplines in an effort to create a "synthesized branch of knowledge" such as work readiness (p. 29). This notion of synthesizing knowledge leads directly to the last stage of the continuum.

Reconstructed Knowledge. The final stage in the continuum, Reconstructed Knowledge, refers to a vision of knowing that takes as its starting point a problem, idea, or concept, and builds knowledge from a variety of areas without regard to disciplinary boundaries. This is best represented by the word *synthesized* (Petrie, 1992). Petrie comments that "the key feature of a truly interdisciplinary general education program is, ultimately, the extent to which the program itself attempts to synthesize the elements of the curriculum instead of simply leaving it to the students" (p. 316). A synonym of *synthesized* (combining parts to form a whole), *integrated* is also used to represent this view of knowledge (Beane, 1991; McIntosh & Meacham, 1992; Vars, 1991). Nissani (1995) uses "degree of integration" to refer to the amount of blending which has taken place, to the point that "the distinctive flavor of each is no longer recognizable, yielding instead the delectable experience of the smoothie" (p. 125). Reconstructed knowledge is also represented as *fused* (Beck, Copa & Pease, 1991; Vars, 1991), describing a new subject that explores issues/concepts from two or more disciplines.

By far the most prevalent practice of this stage occurred during the Dewey-influenced Eight Year Study, which promoted the term *core curriculum*, still in use today (Aikin, 1942; Beck, Copa & Pease, 1991; Petrie, 1992; Tyack & Tobin, 1993; Vars, 1991). Vars (1991) describes *core curriculum* as when "needs, problems, and concerns of a particular group of students are identified, and skills and subject matter from any pertinent subject are brought in to help students deal with these matters" (p. 14). This type of knowledge acquisition is also a principle behind the Coalition of Essential Schools (Petrie, 1992). A number of models (Beane, 1991; Braunger & Hart-Landsberg, 1994; Fogarty, 1991; Jacobs, 1989b; Morrow & Duncan, 1992) call for student-centered and derived curricula within this reconstructed knowledge stage. Some

of these student-centered models (Beane, 1991; Braunger & Hart-Landsberg, 1994) call this approach *integrative*, suggesting that "at the intersection of questions and concerns from early adolescents and from the larger world, we may begin to imagine powerful themes that connect the two and thus offer a promising possibility for organizing the *integrative* curriculum" (Beane, 1991, p. 11, italics added).

PROGRAM CHARACTERISTICS

The reviewed literature included descriptions of interdisciplinary programs in practice. These descriptions provide insight into where interdisciplinary programs occur, the types of combinations that characterize interdisciplinary education, and the disciplines that are combined in grades five through twelve (see Tables 1 and 2). In order to present a picture of what the programs in the reviewed literature look like, descriptions of different aspects of one program (e.g., Humanitas[2], The Eight Year Study) were treated collectively and counted as one program. Similarly, single articles that discussed several programs that are different in approach but similar in the types of disciplinary combinations were treated collectively and counted only once (e.g., Beck, Copa & Pease, 1991). As a result, we concluded that the reviewed literature described eighteen different programs.

Fourteen of these programs occur at the high school level, five are implemented in the middle schools and one program occurs at both the middle and high school levels. This small sample does not allow us to make a conclusion about where interdisciplinary programs are most likely to occur, but it does seem to challenge the assumption that interdisciplinary education is more prevalent in the middle school. We find this surprising since the middle school is often regarded as the "natural home of interdisciplinary education" (Beane, 1991). This raises a few questions. Are interdisciplinary programs more likely to occur at one level than at another? If so, why? Is it possible that the integration of disciplines is so common in the middle school that it is overlooked as the focus of discussion?

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[2] The Humanitas program was concisely described by Aschbacher (1991a) as follows: "Humanitas is an interdisciplinary, thematic, team-based approach to teaching the humanities. Its purpose is twofold: to promote teachers' professional growth and to improve humanities education for the full range of students." (p. 16)

Table 1

Types of Combinations	Percent (Frequency)
Within one discipline	17 (3)
Two disciplines	39 (7)
Three disciplines	17 (3)
Four or more disciplines	11 (2)
Vocational and disciplinary content	17 (3)

n=18
Not equal 100% due to rounding.

Table 2

Disciplines or Subjects Combined	Percent (Frequency)
English and History/Social Studies	28 (5)
English, History/Social Studies, Mathematics, and Science	6 (1)
English, History/Social Studies, and Computer Technology	6 (1)
English, History/Social Studies, and the Arts	11 (2)
English and Science	6 (1)
English and Health	6 (1)
Sciences	11 (2)
English, History, Civics, Arts, Mathematics, Etc.	6 (1)
History/Social Studies	6 (1)
Vocational and disciplinary content	17 (3)

n=18
Does not equal 100% due to rounding.

Where interdisciplinary programs are implemented is important, regardless of where they are most prevalent. We believe that interdisciplinary programs at the high school level may be quite different from those at the middle school due to scheduling, issues of seat time, planning, and related concerns. The reviewed literature however, does not address the unique differences, challenges, and benefits that characterize interdisciplinary programs at the high school and middle school levels. Therefore, we make little distinction between high school and middle school programs.

Seventeen percent of the programs focus on integration within a single discipline. For example, integration within science may combine biology and chemistry. Combining two disciplines is most common (39%) among these programs, and three disciplines are combined in seventeen percent. Eleven percent of the programs describe combinations among four or more disciplines. Finally, seventeen percent of the programs combine vocational courses with academic disciplines in unspecified numbers.

While English and history/social studies are most often combined with other disciplines, all traditional subjects were represented at least once in the eighteen programs. Specifically, English and history were combined in twenty-eight percent of the programs. English and history were combined with math and science in six percent of the programs; with computer technology in six percent; with civics, the arts, math and other subjects in six percent; and with the arts in eleven percent of the programs. English and science were combined in six percent of the programs, as were English and health. Eleven percent of the programs demonstrated combinations within the sciences and six percent showed combinations within social studies. The remaining seventeen percent combine vocational content with nonspecific academic disciplines or content.

The literature also included information that allowed us to understand how interdisciplinary programs are designed (Table 3). Only one program synthesizes and blends the disciplines. Fifty-six percent of the programs are interdisciplinary, integrated or have a broad-field curriculum design. A complementary, webbed, correlated, parallel or sequenced curriculum is described in twenty-seven percent of the programs. Due to insufficient information, it was not possible to comment on the design of twelve percent of the programs described.

Table 3

Program Design	Percent (Frequency)
Synthesized, blended, fused, core-curriculum, problem-centered	6 (1)
Active thematic, interdisciplinary, integrated, broad-field curriculum	56 (10)
Multi-disciplinary, complementary, correlated, parallel, sequenced, webbed	27 (5)
Unable to determine	12 (2)

n=18

On the interdisciplinary continuum, programs included within these three groups should reflect knowledge that is reconstructed, shared and correlated respectively. However, simply designing programs in ways that should represent particular kinds of knowledge on the interdisciplinary continuum does not ensure that the desired ways of knowing will be achieved or that the programs will be characterized in ways that are congruent. Further information is needed to determine whether or not these programs truly represent these types of knowledge and reflect the ways in which it is characterized.

In the reality of school, interdisciplinary education looks different than it does in theory. It is far less definitive in practice. In fact, actual interdisciplinary programs often reflect a variety of the notions put forth in the literature that seeks to define it. Using the interdisciplinary continuum as a way of visualizing interdisciplinary education in practice can illustrate this point. It is possible to consider the three types of knowledge as the goals or objectives of the interdisciplinary program and the ways in which knowledge is represented and characterized as the program design and instruction. In practice, it is possible to establish one type of knowledge as the goal or objective but design the program and approach instruction in ways that are not representative or characteristic of such knowledge. In doing so, it is difficult, if not impossible, to achieve the desired way of knowing. This mismatch between program goals, design, and instruction is demonstrated in the studies that provide us with a sense of what the interdisciplinary curriculum looks like in practice.

THE CURRICULUM IN PRACTICE

Although there is a preponderance of self-reported success with interdisciplinary programs, actual research within middle and high school interdisciplinary classrooms is rare. Reviewing research that does look directly at classroom practice is complicated by the tendency for interdisciplinary research to be part of a larger reform package. An in-depth examination of classroom research on the effects of interdisciplinary education poses several additional challenges: obtaining data around the researcher's particular focus (the interdisciplinary thrust of the course may be secondary to the researcher's primary interests), separating out the particular impact of interdisciplinary teaching within the many variables that affect the classroom environment, and identifying realigned boundaries between disciplines. Instead of trying to identify specific factors, then, this review examines research-based descriptions of the interdisciplinary classroom -- in particular, English/history combinations -- comprising the classroom-based research portions of McQuillan and Muncey (1994), Miller (1996), Muncey and McQuillan (1996), Cohen (1995), Levstik (1986), and Ross (1982). Specifically, we examine the classroom curriculum, pedagogical practices, assessment, and outcomes. In order to better determine how the interdisciplinary classroom differs from the classroom of a single discipline, Sturtevant's (1996) case studies of two history teachers' beliefs, philosophies, and practices in non-interdisciplinary classrooms are used for comparison.

Classroom Curriculum

It is instructive that while each of the five studies of English/history combinations aim for creating Shared Knowledge, three of the five (Levstik, 1986; Muncey & McQuillan, 1994, 1996; Ross, 1982) primarily represent knowledge in a sequential fashion, following the chronology of the history curriculum (Miller's and Cohen's sites focused upon active thematic units, though within these units sequential connections are often made.). Utilizing sequential combinations typically correlates historical and/or period fiction with historical events -- for example, reading Chaucer while studying the Middle Ages, reading *The Scarlet Letter* while studying the Puritans.

In these cases, the combination aims to achieve Shared Knowledge in its intent to produce "narrative-historical insight" (Miller, 1996, p. 41). A primary characteristic of Shared Knowledge, however, is the mutually-supportive nature of the disciplines involved (in this case, English and history). This characteristic does not always emerge in the teacher-participants' stated understandings of the role of the disciplines. A teacher in Muncey and McQuillan's (1996) study elaborates on his goals for students: to "give them some sort of basis from which to understand who they are and to foster in them a desire to look at the details of living, because it is the details that make history what it is" (p. 174). Compare these statements with Sturtevant's (1996) discussion of beliefs held by the non-interdisciplinary history teachers in her study: "for the most part, literacy activities were incorporated into a system of instruction, with the purpose of helping students learn history" (p. 248). Although Shared Knowledge best represents the expressed goals in each situation, teachers are, in fact, using representations of Correlated Knowledge (see Figure 1) which create an environment in which English is largely used in support of the history curriculum. In an article addressing a similar situation, Noskin (1997) relates how, in his first month of teaching in an English/history combination, he "allowed the history curriculum to substitute as a purpose or guiding force for English" (p. 59). Later he realized that, though not consciously, he had "perceived [English] as a vehicle, or even a catalyst, for making connections with the other subjects" (p. 60). This does not fulfill a critical characteristic of Shared Knowledge, which is that the disciplines be mutually supportive of one another.

Even the use of active thematic combinations (Cohen, 1995; Miller, 1996) to create Shared Knowledge may not utilize the disciplines in a mutually supportive way. For example, in Miller's study, the teacher-participants explain one purpose in using literature as "providing insight and understanding into events in history" (p. 13). The thematic units chosen reflect the course emphasis upon historical events: Immigrant/Native American Experiences, Justice and Oppression, Labor, and Education. Although these units would not be entirely out of place in an English curriculum, they fit much more comfortably into that of a history class. The fact that literature was selected to fit into these units indicates that curriculum resources were largely history-driven. Cohen's participants utilize thematic units in ways that do seem to produce mutual support. For instance, one stated goal included "to have kids see the complexity of

problems, not just go for the simple solutions" (p. 60). Their methods supported this goal in their choice of units which included such themes as "Change" and "The City." However, though in theory they fulfill the characteristics of Shared Knowledge, problems with implementation make it difficult to gain a clear picture of how well they achieved it in practice.

Pedagogical Practice

Teachers in these studies tended to utilize student-centered, collaborative classrooms that were frequently project and/or discussion-based. Excerpts from Muncey and McQuillan's (1996) observations on 'a day in the life' segment of a 9th grade class studying World War II demonstrate positive teacher practices: students "made connections . . . they were respectful . . . they were to assert and defend personal beliefs . . . [the teacher] accommodated a variety of learning styles" (p. 226). Miller's (1996) teacher-participants infused their curriculum with a problem- posing, discussion-based pedagogy, and strong beliefs in multiple ways of knowing. Cohen (1994) chronicled teachers in their first two years of a developing program, struggling to encourage democracy and empowerment amidst a student population "who called out with equanimity whatever feeling or sensation seemed to momentarily enter their mind" (p. 47).

While it is possible that something about interdisciplinary teaching somehow encourages a particular pedagogy, only one of these practices, "multiple ways of knowing" (Miller, 1996), appears significantly different from what one might expect to find in the classroom of any progressive educator, in any single discipline. The tendency of Miller's teacher-participants to "problematize uncritical ways of perceiving" (p. 25) directly conflicts with Sturtevant's (1996) participants, who believed in teaching the facts, with some measure of interpretation included. One participant likened it to "completing a jigsaw puzzle and believed that, to understand the whole picture, students had to understand each of the parts" (Sturtevant, 1996, pp. 244-245). It is possible that the interdisciplinary content of the course -- especially the influx of a variety of literature -- created an environment where a 'fixed' view of history no longer existed. Additionally, James Banks (1981) supports the notion that literature (particularly multicultural in emphasis) taught across subject areas can present alternatives to a uniform understanding of

history. Unfortunately, none of the other research studies looks at this particular practice, other than to emphasize problem-solving and discussion, two techniques which may encourage multiple interpretations.

Assessment

It is surprising and encouraging, given the largely history-driven content of most of the researched classrooms, that assessment, unlike what may be found in a traditional history or English class, tends to support both disciplines. For instance, Miller (1996) describes assessment strategies, which, though overwhelmingly history-driven -- two research papers, multiple source/media anthology on a theme from history, and a paper on the 'American Dream' -- do include "22 pieces of writing of mixed creative and expository genres (e.g., children's story, college application essay)" (p. 5) as well as a personal response journal "used often as a means of entering into further discussions with the life and mind and conditions of the characters in texts" (p. 37). Muncey and McQuillan (1996) provide examples of creative assignments that take from both disciplines, including "an essay in which students interpreted Macbeth in terms of Machiavelli's philosophy" (p. 181). Cohen (1995) describes a "dizzying" array of projects that span domains from both disciplines; including "a large research paper, a position paper, an exhibition, a study of the school's code of conduct, and other work, all considering a wide range of legal issues" (p. 61). Missing from almost all of the research is an in-depth study of how the classroom interactions progressed to the assessment stage. If one accepts that evaluation does to some degree drive the curriculum, however, then it can be assumed that the interactions in these classrooms necessitated more mutual support than their sequenced approach indicates.

Literacy Practices

This section describes how the interdisciplinary thrust of the described courses influences student literacy practices. Two primary changes in literacy practice are suggested by the literature.

The first relates to the use of historical fiction in forming a sense, on the part of the student, that they have gained a deep, personal knowledge of history (Levstik, 1986; McQuillan & Muncey, 1994; Miller, 1996; Ross, 1982). Thus one of the often stated goals in history/English combinations does appear to occur, though not without complications. Ross (1982) notes that students exposed to World War II historical fiction gained a personal form of knowledge despite the fact that they were not provided with a solid historical background of the war. Specifically, they "did have a feeling for the protagonist and were able to identify the theme" (p. 210). McQuillan and Muncey (1994) offer an 11th grade student's comment demonstrating the personal connection she made between subjects:

> It's also easier to understand because English helps you with the history and the history helps you with the English, because the history tells you how people were and whole outlines. But then the English gives you examples. You feel what the people felt. (p. 273)

Levstik (1986) concurs, adding an emotional connection: her sixth grade participants "talked about being moved, inspired, and angered at times by what they read, and they frequently added that they had learned something that they described as the truth" (p. 10).
This problematic notion of finding the 'truth' from fiction surfaces in two reports. Ross (1982) comments that "the students involved in the study, for the most part, seemed to view what happened in the story as a reality for something that happened in the past" (p. 210). Levstik (1986) adds,

> Students explained that they knew the truth after reading, that they wanted to 'know what happened,' or wanted to understand something from the past. This was particularly true in those instances where humans responded with extraordinary bravery or outrageous inhumanity. (pp. 11-12)

Neither researcher cites a response to correct this situation or discusses its ramifications in terms of 'knowing'. A teacher in Muncey and McQuillan's (1996) study, however, does comment on what he perceives as a problem with the literature component of the class: "The history doesn't come as alive for them as what they read that's literary. And yet I helped them fully make the connections..." (p. 178). He also reported that students appeared to be more excited about the English/creative writing portion of assignments than about the history portions.

A second change in literacy practices is described only in the studies of Ross (1982) and Levstik (1986); this change relates to how the study of historical fiction may impact writing practices. Using Britton's terms for classification, Ross notes that students tended to use a written response that matched the fictional discourse they were reading. In writing about history, "the expressive and the poetic were selected by a clear majority of students over the transactional" (p. 210). Levstik's data concurs: "As writers, the children adopted the storyteller's voice rather than the more distant and impersonal reportorial tone. They attempted to engage their audience with the same elements that had first appealed to them -- a more personal narrative structure" (p. 14). Moreover, Levstik notes, students adopted a more personal sense of audience in their writing than is normally the case in historical texts.

It is clear from both studies that the uses of historical fiction, though potentially problematic in differentiating fact from fiction, enrich history study and writing. It is less clear how this affected students' studies in English. For example, aside from teaching about the life and times of the author, how might some facet of history enrich the study of non-historical fiction? In other words, can a balance be struck between the disciplines so that both are equally represented in student literacy practices?

When looking at interdisciplinary classroom practice one is immediately struck by the level of detail and coordination that such a curriculum requires, even in the simplest 'correlated knowledge' combinations. In most cases, due to the paucity of published interdisciplinary materials, teachers must create from scratch the specific content, instructional methods and assessment that will form the basis for the revised course(s). In doing so, they work together in ways that teachers typically are not asked to do. They may begin interacting with students in new ways as well. If interdisciplinary education is to become a long-lasting movement, the

factors that enable teachers to create successful programs must be understood. Moreover, as much of the literature on interdisciplinary instruction moves from single classroom combinations to school-wide and even district-wide programs (the Los Angeles Unified School District program, Humanitas, for example), larger-scale enabling features become critical. In this next section we look specifically at answering the question, What facilitating factors appear to impact interdisciplinary programs?

FACILITATING FACTORS

Given the wide variety of sources used in this review, it is perhaps surprising that there is so much agreement about factors enabling interdisciplinary education. Multiple sources agree on the need for time: time for planning, training, and blocking courses. Similarly, funding, support, and organizational structures are needs apparent in much of the literature. Combined with these basic requirements are factors that necessitate fundamental changes in the status quo: assessment alternatives and credit/unit restructuring. The last facilitator, collegiality, critically influences each of the previous areas. The literature suggests that the success of interdisciplinary programs does not rest exclusively upon these factors, however, but upon how they are utilized within the climate of the school site.

Time

There is wide agreement that time is an integral and indispensable factor in facilitating successful interdisciplinary programs. Uses of time, however, vary. Common planning time, a common component of middle school restructuring, is often cited as providing teachers with a regular period in which to correlate the various disciplinary strands that make up the curriculum (Aschbacher, 1991a; Brandt, 1991; Cawelti, 1994; Jacobs, 1991a; Miller, 1996; Muncey & McQuillan, 1996; Panaritis, 1995; Tarpey & Bucholc, 1997).

Common planning time is frequently combined with course blocking, a second time-based facilitator. This creates sections of time during which students can be exposed to a variety of

interdisciplinary formats. Improving course flexibility, therefore, would allow a school to experiment with different discipline combinations in order to find the best possible climate for instruction. Braunger and Hart-Landsberg (1994) comment on the results of one such experiment in course blocking at Gladstone[3] High School:

> The schedule that is currently more effective is a shared planning period followed by two block classes with about 25 students each. Wilson teaches English to one group while Stewart holds biology class with the other group; then, at the end of the period, the student groups switch classrooms (p. 11).

Miller (1996), by contrast, studied a different arrangement in a class of 20 students: "Each class was team-taught in double back-to-back periods, separated by [the two teachers'] common lunch and planning period" (p. 6). Mergendoller and Pardo (1991) report that the MacMagic program utilizes a three-period block and mobility of students within three classrooms. Ladwig and King (1992) provide an extreme illustration of course blocking in "Williams" High School's "flexible-modular" scheduling:

> Students met twice per week in large-group (approximately 150 students) classes for 55 minutes, once a week in medium group (60 students or less) classes for 55 minutes, and two or three times a week in small-group (12-20 students) classes for 35 minutes. 'Open labs' were also available (p. 708).

Williams High School's purposes with this schedule were to increase team planning and preparation time as well as to introduce small group discussions.

The necessity of time for staff development, inservice training, and staff meetings also recurs in the literature. Indeed, Tyler (1980) counts the in service workshop, "invented during [the Eight Year Study] to furnish time and assistance to teachers," as one of the prime outcomes of the largely interdisciplinary project. Garcia (1990) reports that teachers involved at an interdisciplinary program at Pajaro Middle School (California) claimed that "without the time the project allotted them to meet and plan, [it] would not have been possible" (p. 12). Aschbacher

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[3] In all cases, school names identified are those fo the original authors. Pseudonyms are indicated in the text by quotation marks. Actual schools (to the extent they can be determined as such) are identified by location (city and state, where given).

(1991a), Aschbacher and Herman (1992), Cohen (1995), Muncey and McQuillan (1996), and Braunger and Hart-Landsberg (1994) also cite staff development, in the form of paid summer training institutes and periodic inservices, as important elements in creating a successful program.

Hord, et al. (1987), in an analysis of effective change facilitators, note that meeting time is important in effective teaming, especially in creating "continuous, typically informal contact" as well as ongoing planning, "constantly reviewed and revised through informal conversations and regularly scheduled team meetings" (p. 86). The MacMagic Program at Davidson Middle School (San Rafael, California), an integration of technology, English, and history, provides continuous team contact in the form of daily staff meetings (Mergendoller & Pardo, 1991). Dobbins (1971) provides insight into the strain such a requirement can place upon the staff involved. Reflecting upon the first two years at the experimental Adams High School in Portland, Oregon, he notes that most of his staff was in a "state of near exhaustion," a result, in part, of the "massive commitment of time" required by team planning (p. 519).

Although there is little disagreement about the need for time for planning and training, there are some caveats offered as to the usefulness of this time in actual practice. For instance, research in the field of staff development indicates that time set aside for this purpose is frequently unproductive in terms of changing teacher attitudes and practices (Guskey, 1986). Ladwig and King's (1992) research on restructuring finds that planning time is also used to varying degrees, depending upon the school. At "Nelson" High School, for example, they note that "there was little evidence that the additional time for preparation and team planning was used to develop an improved focus on higher order thinking. In fact, the extra period for team planning was used infrequently" (p. 703). Contrast this with "Carter" Second School, where teachers met for four hours each week; "the vast majority of this time was spent developing curriculum" (p. 706). Thus although time for staff development and planning is a factor, it is only a facilitator if it is used and valued for its intended purpose.

Panaritis (1995) notes that time in actual practice needs to be used for more than standard team-building activities designed to create activities and to increase respect among colleagues. He suggests that "before a mature professional collaboration can fully develop, every participant needs to become familiar with his or her colleagues' *pedagogy*...and with the elements that affect

those colleagues' *curricula*" (p. 624, emphasis in original). This notion surfaces a number of times in research on interdisciplinary programs within the Coalition for Essential Schools as well (Cohen, 1995; Muncey & McQuillan, 1996). In Cohen's (1995) study of the Quest program, for example, classroom implementation broke down when two teachers who were "essentially incompatible in their philosophies of education" attempted to team teach (p. 50). Although they had spent innumerable hours planning together, Cohen notes that "it had never occurred to any of us to consider the impact of personalities on the dynamics of the classroom" (p. 50). Muncey and McQuillan (1996) cite similar difficulties, noting that when scheduling conflicts threw teachers with differing pedagogies together on a team, "teachers expressed frustration, and classes reverted to being taught separately" (p. 100). Although time is a factor in helping teams work out these differences, these issues surface again in the categories of support and collegiality.

Institutional Support

Due to the extensive development and organization required of interdisciplinary programs, funding requirements generally extend well beyond the cost of materials. For instance, in Aschbacher and Herman's synthesis of their four years of research on the Humanitas Program in Los Angeles (1992), they suggest that the minimal resources required must fulfill the need for overall coordination, administration and counseling commitments, block scheduling of courses and common scheduling of teacher conference times, site coordinators with extra planning time, money for copies and field trip resources, and funding for staff development (p. 3). Cohen (1995) cites a similar need for funding, especially for release time and course compensation, the absence of which "led to circumstances so demoralizing that they caused one talented teacher to leave the field altogether and others to back away from innovation, seeing it as an overwhelming and exhausting enterprise" (p. 105).

The Eight Year Study received over a million dollars in funding from various foundations between 1933 and 1941; Tyack and Tobin (1993) cite the "powerful support from foundations and professional associations" as providing a portion of the "highly favorable conditions" necessary for the study to be successfully implemented (p. 470).

Funding is also crucial for those programs that require low class sizes, or technological innovations. Hord, et al. (1987) suggest that supporting change in a school setting includes "acquiring funding and other unique resources" as a key first step (p. 75), sometimes necessitating "'creative' acquisition of resources," including recruitment of parent volunteers and a 'broad interpretation' of "the guidelines for dispersal of funds" (p. 76). At two of the Coalition schools, the principals' obtaining of financial support from foundations, coupled with increased time for planning, are cited as one reason why the programs received widespread teacher support (Muncey & McQuillan, 1996). Conversely, Brunkhorst (1991) observes that when funding is not obtained it can sideline major portions of programs, which, despite their positive reactions, cannot continue without the necessary resources.

Linked cooperatively with funding are support issues. The literature suggests that external support, specifically in terms of parents, the school district, community, industry, and education personnel, is highly valued in the development of interdisciplinary programs. One school (Garcia, 1990) initiated parent potluck dinners in order to inform and involve parents in their project. An integrated academic-vocational program (Archer, 1989) relied heavily upon industry involvement in providing mentoring programs and a work component for economically disadvantaged students. Dobbins (1971) observes the problems that result when the external support network is out of sync with school personnel: parents, staff, administration, and the community had diverse and sometimes conflicting beliefs about outcomes of the program, contributing to the already overwhelming challenges facing Adams High School. Hord, et al. (1987) suggest that schools can better cope with these situations by establishing a method of "external communication," including "reporting to the Board of Education and parent groups," and "developing a public relations campaign" (p. 75).

District support, not surprisingly, is especially important in interdisciplinary programs, which frequently depart from standard structuring and curriculum formats. In interviews with Humanitas and Los Angeles Unified School District coordinators, teachers, principals, counselors, and an assistant superintendent, Aschbacher (1992a) found consensus that school/ district/outside support was one of "several key elements for a successful program" (p. 16). Ladwig and King's (1992) research concurs: at one interdisciplinary school, situated within a traditional high school, class size, teacher loads, and curricula guidelines were complicated by

the district expectations for the traditionally structured site. Ladwig and King conclude that "without a total school or district commitment to restructuring, substantial structural constraints remain" (p. 705).

Another area where support is needed is in continuity of staffing, of particular concern in interdisciplinary programs due to the working relationship that may develop between administrators, team teachers, students, and the newly developing curriculum. The Eight Year Study, for example, found its emphasis on collaborative teaming to be "potentially unstable because of turnover of teachers" (Tyack & Tobin, 1993, p. 469). Studies of Coalition and Humanitas sites indicate that staffing changes that occur in the midst of curriculum changes can have a devastating impact upon the site (Aschbacher, 1992a; Muncey & McQuillan, 1996). "Evans" High School, for instance, saw a complete restructuring of the interdisciplinary courses when a new principal arrived, asking questions and reprioritizing the curriculum rather than continuing to promote the former principal's program (Muncey & McQuillan, 1996). As reform movements often become identified with an individual or small group, district support becomes paramount to maintaining the balance and cohesion in personnel necessary to propel the reform movement forward.

Organizational structures within interdisciplinary programs can play an important role in mediating and encouraging communication between and within external support groups, teachers, and administration. Several studies cite extensive staffing structures or site coordinator programs that facilitated communication, training, and administrative requirements (Archer, 1989; Aschbacher, 1991a; Cohen, 1995; Garcia, 1990; Hord, et al., 1987). Garcia (1990) describes the extensive organizational responsibilities allotted to the half-time project site coordinator at Pajaro Middle School, including maintaining parent communication, handling weekly and monthly meeting arrangements, and dealing with various local problems. The teachers reported that the coordinator "played a key role" (p. 12). This key role becomes even more crucial when a program becomes widespread. The Humanitas project in Los Angeles, for example, spanned a number of schools; consequently, a structure was established by which teacher-coordinators trained teams at each school. The effectiveness of the organization structure is again dependent upon other facilitating factors, including time, funding, and district support.

Assessment Issues

Although assessment commonly refers to tests or measurements, in this section it is interpreted broadly to include course credit, units, and college requirements as well as state and local achievement tests, classroom exams, and school or district-wide methods of evaluation. Alternative assessment thus refers to other methods of achieving these outcomes, including circumventing them altogether. Within the literature, reports of alternative assessment figure as a facilitating factor in interdisciplinary programs (Braunger & Hart-Landsberg, 1994; Crane, 1991; Miller, 1996; Tyler, 1980). In particular, the Eight Year Study offers extensive evaluation data.

Tyack and Tobin (1993) cite alternative assessment as adding to the "highly favorable conditions" under which The Eight Year Study operated. Specifically, over two hundred colleges were "persuaded . . . to admit highly qualified students on the recommendation of the principals of the schools selected to participate in the experiment" (p. 467). Eliminating standard college admission requirements in the form of courses, units, and exams allowed the program to experiment with different interdisciplinary methods of instruction that often resulted in an amalgamation of disciplines.

Crane (1991) cites another program that has circumvented standard credit requirements in order to facilitate interdisciplinary teaching. At Littleton High School (Colorado), three years of planning in an Integrated Science program have culminated in a replacement of "the current credit-hour-based graduation requirements with 19 performance-based graduation requirements" (p. 41). The new graduation requirements evaluate various science demonstrations that measure skills developed during the two-year integrated course. At Hudson's Bay High School (Vancouver, Washington), students and advisors 'negotiated' credits based upon the ever-changing dimensions of their chosen projects (Braunger & Hart-Landsberg, 1994). The researchers comment that this process helped the school to further instruct "students to articulate their own goals, to perceive and express the value in their activities" (p. 16). However, the report also notes the frustration that teachers and students experience in trying to complete the constant paperwork required to justify the credit alterations. It concludes that "learning activities still tend to be constrained by the way the high school credit structure limits students' choices, as well as their perceptions of what's important to learn" (p. 16).

In addition to credit requirements, at least one program (Brunkhorst, 1991) describes an integrated science program that utilized some portion of state and district guidelines in developing alternate course requirements for a coordinated science program. After searching the California State Framework and the Los Angeles School District guides for themes for each grade level, coordinators created a curriculum of their own; they "planned a spiral approach to connect science topics from grades 7 through 12" (p. 38).

Other programs also experimented with alternatives for required assessment. Miller (1996) notes that the "Lakeview" High School course in her study had obtained a waiver for the state-mandated Regents Examination. Alternative assessment, presumably designed to maintain a high standard of learning in lieu of the Regents Examination while measuring the interdisciplinary (English/history) thrust of the course, included:

> a portfolio of written work, which included a response journal (5-7 pages per week); 2 multiple-source research papers; 22 pieces of writing of mixed creative and expository genres (e.g. children's story, college application essay); an extensive multiple source and media anthology representing a selected historical theme, time period, or event(s); and a culminating American Dream paper, synthesizing students' learning and thinking over the school year (10-15 pages). (p. 4)

College, state, district and school credit and course requirements pose one set of potential challenges to interdisciplinary programs. A second set of issues arises in the form of more direct evaluation -- local program and classroom assessment. The Eight Year Study experienced a conflict in this area almost immediately. Tyler, a member of the study's evaluation team, notes (1980) that "the notion that the high school achievement tests that were then available were appropriate measures of what the students were learning was also recognized as false by the spring of 1934" (p. 31). The task of developing alternative methods of assessment was a long and complicated one, focusing on developing ways to "assess the extent to which the new courses were achieving the objectives sought" (p. 32). (The work was complicated by its attempts to measure the progressive ideals of the interdisciplinary instruction.)

Like Tyler, staff involved in the Humanitas program have discovered that developing alternate methods of assessment is not an easy process. Aschbacher (1992a), reviewing interviews at the Humanitas Teacher Center, concludes that:

> few teachers can write good end-of-unit essay questions after only a week [in training] at the Teacher Center. They have not had any prior background in thinking about essays as assessment, thinking in an interdisciplinary way, or focusing on what students should take away from the unit (p. 28).

This lack of experience in interdisciplinary assessment may carry over to the Humanitas student portfolios, over half of which failed to demonstrate an interdisciplinary understanding of concepts and connections (Aschbacher, 1992b).

One might expect that portfolios would provide a convenient tool for alternative assessment in an interdisciplinary program; they are designed to be process-based, metacognitive in form, and to provide a place to collect a diversity of student work. Contrary to what one might expect, however, portfolios do not appear to be a facilitator of interdisciplinary programs. Of the eighteen programs we reviewed, only two (or 11%), the Miller study (1996) and the evaluation of the Humanitas program (Aschbacher, 1992b), mention portfolios.

However, a much higher percentage of the programs (nine of the eighteen, or 50%) utilized a project-based form of assessment. We speculate that projects may more directly facilitate the objectives of interdisciplinary teaching by involving students in activities that have been designed to require multiple sources of knowledge. In this sense the product-based approach draws upon the principles of activity theory (Leont'ev, 1981), which suggests that when done properly, product-based evaluation creates engagement and motivation on the part of the students. The stated outcomes of activity theory and the often stated claims for interdisciplinary education are remarkably similar.

Collegiality

Collegial is defined in the Random House Dictionary (1978) as "characterized by the collective responsibility shared by each of the colleagues" (p. 179). The literature indicates that this sense of collective responsibility is a critical factor in determining the success of interdisciplinary programs. In a discussion of the characteristics of the "change facilitator teams" in schools, Hord, et al. (1987) note that

> each member of the change facilitator team complements the role of the others; collectively, through sharing and overlapping of assignments, they take responsibility for all the functions. Each member shares a common view of the goals of the school improvement project; there is clarity and agreement about the objectives and directions for the change process (p. 86).

Ladwig and King (1992) document how interdisciplinary classrooms are adversely influenced by teachers who do not share a sense of responsibility for common goals. At "Nelson" High School, for instance, "Little or no commonality existed between these [social studies] teachers' self-expressed department goals" (p. 703). He concludes that "this lack of clear departmental focus is consistent with the high variation among observational ratings of classroom thoughtfulness" (p. 703). Although common goals and a clear focus were not the only factors influencing classroom thoughtfulness, it is not coincidental that those schools with the highest ratings in the study reported higher levels of collegiality.

Aschbacher and Herman's (1992) interviews with staff involved in the Humanitas program reveal the intangible benefits of shared responsibility:

> Team members frequently 'hang out' with each other rather than with other faculty. The bonding that occurs slowly over time as they plan together, share their ideas, and dare to reveal their lack of knowledge makes them feel safer with and more accepted by teammates. They also tend to take care of each other. For example, they will give each other feedback when they feel one is in danger of burning out (p. 26).

This notion of "bonding" between teammates surfaces frequently in the literature. For instance, Tarpey and Bucholc (1997) describe how student evaluations cited the two teachers' rapport as the primary reason for the successful implementation of the course. In fact, "in some ways, they see the team approach more like a marriage" (p. 73). The fact that Miller's (1996) two teacher-participants were actually married to one another may have been a powerful contributor to the success of their interdisciplinary history and English course. The Quest Program's five teachers, on the other hand, developed a bond during the course of the program: by the end of the year, they felt that "the collegiality and shared intimacy that had characterized teacher-teacher relations . . . were ultimately worth the work and worry" (Cohen, 1995, p. 58).

Yet several studies (Aschbacher & Herman, 1992; Cohen, 1995; Muncey & McQuillan, 1996) indicate that as collegiality between teachers involved in the programs increases, relationships with the rest of the school staff decline. This appears to happen for a number of reasons. First, the teachers within the program appear to develop a type of intimacy that sets them apart from the rest of the faculty and may generate resistance from the rest of the staff (Aschbacher & Herman, 1992; Cohen, 1995). One of the teachers in Aschbacher and Herman's (1992) report describes how the insider/outsider atmosphere may actually perpetuate itself:

> If we are mentioned in a positive way in faculty meetings, some teachers feel threatened and are then derogatory. So we try to do the best we can in our classrooms but try not to be visible. It's a no-win situation. You can't make those people be accepting. You just try to work around it. I know other schools have the same problem (p. 19).

Secondly, fears of the consequences of interdisciplinary teaching may create friction -- for example, loss of jobs for courses not included in the teaming, reduced enrollment, or a top-down mandate that everyone teach in this fashion (Muncey & McQuillan, 1996). Additional conflicts arise, both on the part of students, counselors, and teachers, when interdisciplinary courses compete with Advanced Placement courses for enrollment, funding, and status.

The factors facilitating the successful implementation of interdisciplinary education in schools may also necessitate changes in the beliefs, attitudes and practices of school personnel. The literature in this review focuses mainly on the changes facing teachers. It suggests that the successful implementation of interdisciplinary education calls for changes in the way teachers view their role and interact with fellow teachers as well as changes in their attitudes toward teaching and their actual teaching practices.

IMPLICATIONS FOR TEACHERS

Research regarding the ways in which teachers are influenced by interdisciplinary curriculums is fairly limited (Kain, 1993). However, advocacy articles and program descriptions suggest that, when put into practice, interdisciplinary education presents teachers with unique

challenges, changes, and potential benefits. An interdisciplinary curriculum forces teachers to reconsider their role as expert and teacher of a single discipline. Additionally, successful implementation of an interdisciplinary curriculum necessitates changes in staff relationships. Teachers need to relate to their colleagues in new ways and with greater frequency. Finally, involvement in interdisciplinary curriculum can influence teachers' attitudes toward teaching by generating enthusiasm and interest in teaching. Unfortunately, it can also contribute to job related discomfort and anxiety.

Changes in Teachers' Perception of Role

The greatest challenge facing teachers involved in interdisciplinary education may be to overcome the notion that they have limited expertise and are restricted to teaching the concepts and skills of only one subject or discipline. This is extremely difficult to do since any "move to interdisciplinary approaches to instruction requires altering [teachers'] basic sense of identity and efficacy" (Kain, 1993, p. 324).

Traditionally, secondary level teachers' professional identities are tied to their subject areas (Brandt, 1991; Kain, 1993; Muncey & McQuillan, 1996; Siskin, 1994). Historically, teachers are trained to work alone as experts in one discipline. They become accustomed to the autonomy that their role provides. Interdisciplinary education cannot be implemented successfully if teachers hold these beliefs. Successful involvement in interdisciplinary education requires that teachers "let go of old models" (Drake, 1991, p. 20) of teaching and curriculum development.

Changes in Staff Relationships

Teachers' ability to transform their notions about teaching and the disciplines seems to contribute to the types of staff relationships that facilitate the success of interdisciplinary programs. As teachers begin to understand their role differently, they begin to interact with one another in a different way. For example, teachers who hold dissimilar views on instruction and

learning may find that they must work collaboratively in order to understand unfamiliar content, overcome erroneous assumptions, and develop interdisciplinary curricula (Dobbins, 1971). As teachers' perceptions change, communication and collaboration among them generally increases and improves (Kain, 1993).

In an article describing the ways in which vocational and academic teachers developed and implemented interdisciplinary programs, Beck, Copa and Pease (1991) state that as a result of interdisciplinary teaching, "Communications among colleagues at the two high schools changed dramatically" (p. 31). Collaboration improved as well. Teacher comments include: "'before I would have stayed in my room and graded papers, but now I walk down to his room to talk about our work'; 'I have a better idea of what others are doing'; and 'I had taught groundwater quality before, but never with the water conservation people as resources'" (p. 31). This indicates that teachers involved with interdisciplinary programs are not only more knowledgeable about what others are teaching, they are also more willing to introduce new skills and concepts in their classrooms.

Likewise, teachers involved in restructuring science education by integrating the sciences and eliminating the hierarchy of school science claim that they are forever changed for the better (Brunkhorst, 1991). Teachers request more opportunities to meet with each other and tend to communicate more frequently.

Little and Bird (1984) refer to collaboration and communication as "joint action." There are three types of joint action: coordination, which describes teachers working toward or under a common framework; accommodation, which describes teachers acting in response to another teacher; and cooperation, which describes one on one interactions among teachers in an attempt to achieve a common goal (pp. 10-11). Little and Bird identify interdependence among teachers and opportunity to act together as the conditions necessary for joint action to occur (p. 11). Clearly, interdisciplinary programs provide these conditions.

Changes in Attitudes toward Teaching and Teaching Practices

Curricular changes that alter the way teachers perceive themselves and their interaction with

other professionals can also lead to changes in their attitudes toward teaching and in the ways they teach. Even though interdisciplinary programs may require greater effort, time commitments, and work load (Aschbacher & Herman, 1991; Dobbins, 1971), most teachers experience renewed enthusiasm and enjoy their work as a result of participating in the program (Muncey & McQuillan, 1996). Many teachers attribute this renewed interest in the field to their team teaching experiences. Working collaboratively provided them with opportunities to develop new interests, learn new content and methods and receive constructive feedback (Aschbacher & Herman, 1991; Beck, Copa & Pease, 1991; Panaritis, 1995).

Unfortunately, not all changes in attitude are positive. Interdisciplinary programs that do not allow teachers to determine the connections between their content area and other subjects can cause teachers to feel threatened by the teaching material with which they are uncomfortable and unfamiliar (Palmer, 1991). Some teachers are overwhelmed by their feelings of discomfort. Fortunately, other teachers learn to use it to their own advantage and that of their students:

> [T]he interdisciplinary approach might have encouraged teachers to model certain thoughtful behaviors in their classes: to be continually learning themselves, to acknowledge the difficulty of gaining a definitive understanding of a topic, and to consider alternative solutions and reasons to challenging tasks (Ladwig & King, 1992, p. 705).

This openness, in conjunction with the research of Miller (1996), Levstik (1986), Cohen (1995), and Ross (1982), suggests that interdisciplinary education creates room for learning and instruction that is less authoritarian. This indicates that interdisciplinary education has the potential to foster shared learning experiences among teachers and students who view themselves as co-learners. Changes such as these will have implications for what students learn as well as how they learn it and the ways they react to it.

IMPLICATIONS FOR STUDENTS

Overall, the literature suggests that participation in an interdisciplinary curriculum is associated with positive changes in achievement, behavior and attitude. These changes are

claimed to occur regardless of how the interdisciplinary program is designed and implemented or who participates in it. In fact, it seems that every type of student has something to gain from the inter-disciplinary curriculum. Participation in an interdisciplinary program may afford low achieving students (Archer, 1989; Martinez & Badeaux, 1992), economically disadvantaged students (Archer, 1989), minorities, and students with Limited English Proficiency (Garcia, 1990) with improved academic achievement, self-esteem, and attendance rates. Furthermore, in comparison with mainstream and higher achieving students, it is possible that these students may experience personal and academic successes that are similar in type if not in degree (Aschbacher & Herman, 1991, 1992; Aschbacher, 1991a, 1991b, 1992b; Mergendoller & Pardo, 1991).

Changes in Achievement, Behavior and Attitude

Garcia (1990) looked at a California middle school with a large minority population (90% Hispanic, 60% LEP) performing one to two grade levels below average. Students participating in the integration of reading, writing, science, social studies, and math demonstrated improvement in reading comprehension, writing, and vocabulary through increased scores on the California Test of Basic Skills (CTBS), Language Assessment Scales (LAS), and Spanish Assessment of Basic English (SABE). Similarly, students labeled as low achievers (Martinez & Badeaux, 1992), economically disadvantaged, or at risk (Archer, 1989) demonstrated improvements in grade point averages associated with participation in an interdisciplinary programs. Specifically, 83% of fifteen students enrolled in a welding class integrated with English and math improved or maintained their overall GPA in academic course work. Ninety percent of the students improved or maintained their average in welding (Martinez & Badeaux, 1992). Also, students enrolled in an integrated academic-vocational program showed greater improvement in GPA and number of credits earned than students in a comparison group (Archer, 1989).

Research examining the effects of integrating cardiovascular health education with an eleventh grade English class attempted to show that integrated instruction could "maintain and enrich the cardiovascular knowledge and attitudes attained in their previous health education courses" (Holcomb, et al., 1984, p. 339). Pretest, post-test and retention studies of two treatment

groups and one control group showed that fifteen months after instruction had ended, students in the integrated program demonstrated higher levels of retained knowledge about cardiovascular health than students who were not in the integrated program. It should be noted, however, that the fifteen month retention test did not show any statistically significant difference between groups with regard to attitude toward their ability to control cardiovascular health risks.

Improvement was also found in high school students enrolled in Humanitas, a thematic curriculum designed to provide average students living in urban settings with large minority populations "with opportunities to develop critical thinking, writing, and discussion skills and to give them a sense of ownership in the learning process" (Aschbacher, 1991b, p. 16). Students in the program "wrote essays with better overall quality, more conceptual understanding of history and more interdisciplinary references than comparison students" (Aschbacher & Herman, 1991a, p. xiv). Moreover, "traditionally low achieving students [in the program] make gains in essay quality equivalent to those of higher achieving students" (p. xiv).

Students themselves believe that participation in an interdisciplinary program improves their learning. Middle school students representing a variety of cultures, native languages, economic, behavioral and academic backgrounds were enrolled in the MacMagic program, which used technology to enhance learning in an integrated English, history and multimedia course. These students consistently rated the program as having an above average, positive impact on their spoken English, reading and writing (Mergendoller & Pardo, 1991).

Interdisciplinary programs are associated with positive long-term effects for students as well. Results from the Eight Year Study show that students at the most experimental schools were "strikingly more successful in college than students at the least experimental schools" (Aikin, 1942, p. 113). Moreover, Tanner (1989) reports that students in the Study "demonstrated better attitudes toward learning, greater intellectual curiosity, and higher achievement in college than their peers who had completed the more traditional college preparatory program" (p. 8).

Additionally, improved attendance rates and decreased dropout rates appear to result from student participation in interdisciplinary programs (Archer, 1989; Aschbacher, 1991a, 1991b). Students seem to have fun and enjoy learning (Tarpey & Bucholc, 1997). They also appear to experience gains in self-esteem (Archer, 1989; Mergendoller & Pardo, 1991) as well as a sense of caring among their teachers (Aschbacher, 1991b).

Supporting the Claims

While the claims of academic improvement and positive influences on students' behavior and attitude sound encouraging, they are, in most cases, unsubstantiated by rigorous research methods and analyses. Although numerous articles report academic gains and positive changes in student affect, few authors support their findings with actual data, analyses, and descriptions of methods. Descriptions of quantitative data collection and analyses do support findings reported by Aikin (1942) for the Eight Year Study, and Aschbacher (1991a, 1991b, 1992a, 1992b) and Aschbacher and Herman (1991, 1992) for the Humanitas program. Holcomb, et al. (1984) also provide adequate descriptions of data collection and analyses examining the effects of integrating English and health education. Other cited authors (Archer, 1989; Garcia, 1990; Martinez & Badeaux, 1992; Mergendoller & Pardo, 1991; Tarpey & Bucholc, 1997) do not provide data, measures or analyses that adequately substantiate their claims.

CONCLUSION

The overwhelming support for interdisciplinary education suggests that this form of instruction may be beneficial to both teachers and students. Teachers report increased enthusiasm and renewed interest in teaching, in spite of potential threats to their professional identities as experts in one subject. Indeed, as a result of overcoming this challenge, teachers report increased interdependence and collegiality among their teaching peers. Students of all academic and cultural backgrounds are also reported to experience a variety of benefits. Reports claim primarily positive outcomes in achievement, behavior, attitude, literacy practices, and student learning experiences that parallel real world problem-solving to a greater degree.

Unfortunately, the benefits of interdisciplinary education are not firmly grounded in theory and research. Similarly, practical accounts are largely anecdotal in nature and thus cannot clearly inform future practice. The literature in interdisciplinary teaching, therefore, presents implications for theory, research, and practice -- and for the development of links between them.

Implications for Theory and Research

Given what is known about interdisciplinary teaching, interested researchers are in an opportune position to expand upon a number of areas. The merging of disciplines in their various combinations affects all aspects of the educational environment, including teacher and student roles and relationships, school resources and structure, collegial relationships, assessment, and curriculum development. These areas need to be examined in order to understand how interdisciplinary teaching impacts the educational experience today. However, as noted, research in this field is complicated by several factors. First, outcomes are hard to measure, due to the difficulty in isolating the interdisciplinary component of the classroom, and complicated by the inclusion of interdisciplinary teaching into other reform efforts. Second, the lack of an established theoretical foundation may pose a problem in extending conclusions to past research. Third, the nature of interdisciplinary teaching complicates analysis of classroom practice. It raises questions, for example, about how teachers' notions of the relationships between the disciplines inform curricular goals and the classroom methods used to attain them. The interdisciplinary continuum we introduce indicates that ways of conceptualizing knowledge suggest representations that can be translated into pedagogical approaches. Choices of conceptualizations and representations may affect treatment of the disciplines. For example, when teachers conceptualize knowledge as shared, they may represent this with a thematic (active) curriculum that may be translated into mutually supportive disciplines. Research can be crucial to understanding how theoretical models such as these function in practice.

Implications for Practice

Practitioners interested in developing and implementing interdisciplinary programs should address several considerations. Among facilitating factors, the importance of time, staff development training, funding, and external support cannot be overstated. However, each of these factors is shaped by the degree of collegiality shared within and between staff members and

administration at the school site. Research indicates that shared beliefs about definitions, goals, and methodology foster reform and restructuring efforts and better allocate resources. School personnel, students, and parents may need to reconsider established notions of "what counts" as evidence and measurements of learning. These measurements include such traditional benchmarks of learning as graduation requirements, grades, credits, standardized tests, and forms of participation.

Links between Theory, Research, and Practice

Future research can have a significant impact upon the clarification of present theory by demonstrating the implausibility of retaining discrete notions of interdisciplinarity in the face of a more fluid understanding that better reflects practice in actual classrooms. In doing so, it will contribute greatly toward creating agreement with regard to a common language and shared vocabulary, thus making it possible to broaden the field.

Aside from terminology, we would like to see gaps in the literature addressed. Specifically, do the outcomes of the three different curricular approaches (described as Correlated, Shared, and Reconstructed Knowledge) differ? If so, how? What does each contribute to our notions of what counts as learning? And lastly, does the interdisciplinary continuum need to reflect additional conceptions of knowledge? We would hope that addressing these issues will help us to sharpen our understanding of the possibilities and pitfalls involved in interdisciplinary planning, implementation, and evaluation.

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